UNIT-2

ENVIRONMENTAL POLLUTION

POLLUTION*(2marks)*

- Environmental pollution can be defined as ***"the unfavorable alteration of our surroundings."***
- It changes the quality of air, water and land which interferes with the health of humans and other life on earth.

TYPES OF POLLUTION*(2marks)*

- Air pollution
- water pollution
- soil pollution
- marine pollution
- noise pollution
- thermal pollution and
- Nuclear hazards

Chemical composition of atmospheric air:*(2marks)*

- Nitrogen = 78%
- Oxygen = 21%
- Argon (Ar) = < 1
- CO_2 = 0.037
- Water Vapour = remaining
- O_2, He, NH_3= Trace amount

(AIR POLLUTION

Air pollution is defined as**, *"the presence of one or more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings, plants and animals."***

Common air pollutants sources & their effects:

Substance	Nature	Sources	Health effects	Environmental effects
Carbon monoxide (CO)	Colourless, odourless, poisonous gas. Formed during incomplete combustion offuels $2C + O_2 \rightarrow 2CO$	Cigarette smoking, incompleteburning of fuels, motor vehicle exhaust	Causes headaches, anemia, coma,irreversible brain cell damage &death	Increases the global temperature
Nitrogen dioxide (NO_2)	Reddish-brown irritating gas & givesphotochemical	Fuels burning in vehicles,industrial plants	Lung irritation & damage	HNO_3 acid deposition damage trees, soils, &aquatic

	smog, Can be converted to nitric acid NO_2 + Moisture → HNO_3			life. It corrode metals, stones onbuildings, statues, monuments etc.
Sulphur dioxide (SO_2)	Colourless, irritating gas. Formed bycombustion of coal & oil. Can be converted to sulphuric acid in atmosphere	Burning of coal, industrialprocess	Breathing problems	Reduce visibility, acid deposition on trees, soils & aquatic life
Suspended particulate matter(SPM)	Includes variety of particles & droplets (aerosols).	Burning coal in industries, diesel in vehicles, agriculture, unpavedroads, etc	Nose & throat irritation, lung damage, bronchitis, asthma, cancer	Reduce visibility, acid deposition, H2SO4 droplets damage trees, soils & aquatic life
Ozone (O_3)	Highly reactive irritating, unpleasantodour gas. A major component of Photochemical smog.	Nitrogen oxides, chemicalreaction with volatile organic compounds	-	Moderates the climate
Photochemical smog	Brownish smoke formed duringautomobile traffic	Formed due to chemical reaction among nitrogen oxides & hydrocarbon	Breathing problems, cough, eye,nose & throat irritation, heart diseases	Damage plants & trees. Smog reduce visibility
Lead (Pb)	Solid toxic metal	Paint, smelters, lead manufacture,storage batteries, leaded petrol	Brain & nervous system damage,mental retardation in children, digestive & other health problems,cause cancer	Can harm wild life
Chromium	Solid toxic metal ,	Paint, smelters, chromiummanufacture, chromium plating	Perforation of nasal septum, chrome holes, ulcer, central nervous system disease, cancer.	

Sources of air pollution

- Natural pollution - volcanic eruptions, forest fires, biological decay.
- Man – made activities – Thermal power plants, agricultural activities.

Classification

- ***Primary pollutant***– these are those emitted directly in the atmosphere in harmful form like CO, NO.
- ***Secondary pollutant***– these may react with one another or with the basic components of air to formnew pollutants.

Control Measures:

1. Source control

- Use only unleaded petrol
- Use fuels that have low sulphur and ash content
- Plant trees along busy streets because they remove particulates and carbon monoxide and absorb noise.
- Industries and waste disposal sites should be situated outside the city centre.
- Use catalytic converters to help control the emissions of carbon monoxide and hydrocarbons.
- Houses, schools, restaurants & park should not be located on busy street

2. Control measures in Industrial centers

- Emission rates should be restricted to permissible levels
- Air pollution control equipments must be made mandatory
- Continuous monitoring of the atmosphere to know the emission level

Equipments used to control air pollution:

- Mechanical devices such as scrubbers, cyclone separator, bag houses & electro-static precipitators, reducingparticulate pollutants.

Acid Rain

(16 marks) or (8 marks)

- Normal rain is slightly acidic due to CO_2 gas.
- The pH of the rain water is further acidic due to SO_2& NO_2 gases.
- This type of precipitation of water is called **acid rain.**
- It is also called as **acid precipitation** or **acid fog** or **acid snow.**

Formation of Acid rain:

- Thermal power plants, industries, & vehicles release nitrous oxide & sulphur dioxide into atmosphere.
- When these gases react with water vapour they form acids

$$SO_x + H2O \rightarrow H_2SO_4$$
$$NO_x + H2O \rightarrow HNO_3$$

Effects of acid rain:

1. On Human beings

- Destroy life – nervous, respiratory and digestive system
- Causes premature death from heart and lung disorders like asthma &bronchitis.

2. On Buildings

- Taj Mahal in Agra suffer due to H_2SO_4 acid fumes released from Mathura refinery.
- British Parliament building suffered due to H_2SO_4 rain
- Acid rain reduces the value of building, bridges, cultural objects etc.
- This increases the maintenance cost.

3. On terrestrial and Lake Ecosystem

- Reduces rate of photosynthesis, growth of crops, Fish population.
- Flies, mosquitoes & worm occur on the dead fishes
- Nitrogen, & phosphorous stay up in dead wastages.
- Biomass production is reduced & fish population decreases.

Control measures:

- By Clean combustion technologies
- Using pollution control equipments
- Replacement of coal by natural gas
- Liming of lakes and soils.
- Coal with lower sulphur content can be used
- Emission of SO2 & NO2 from industries can be reduced

WATER POLLUTION

Water pollution is defined as,***"the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life."***

sources(causes) of water pollution:

- **Infectious agents:** Bacteria, viruses, protozoa and parasitic worms from human and animal wastes.
- **Oxygen demanding wastes:** Animal manure and plant debris that can be decomposed by aerobic bacteria.Oxygen demanding wastes from sewage, paper mills, and food processing facilities.

- **In organic Chemicals:**Water soluble inorganic chemicals from industrial effluents, household cleansers.
- **Organic chemicals** such as Oil,gasoline,plastics,detergent
- **Plant nutrients** such phosphate, ammonium, nitrate from sewage, manure, fertilizers.
- **Radioactive materials** such as radon, uranium, thorium from nuclear power plant, mining.
- **Thermal pollution (Heat)**: Water cooling of electric power plants and some types of industrial plants.
- **Point source:** Pollutant discharged at specific location through pipes, ditches into water bodies

  ex: factories, sewage treatment plants, oil tankers.
- **Non-point source:** Large land areas that pollute water by subsurface flow or deposition from atmosphere.

  ex: acid deposition, runoff chemicals.

Effects of water pollution:

- Wastes can degrade quality by depleting water of dissolved oxygen.
- Affect aquatic life.
- Genetic mutations, birth defects and certain cancers.
- Lowers dissolved oxygen levels and makes aquatic organisms more vulnerable to disease and toxic chemicals
- unusable for drinking, skin cancer, harm aquatic life, lower crop yield
- When a power plant first opens or shuts down for repair, fish and other organisms adapted to a particular temperature range can be killed by the abrupt change in water temperature known as thermal shock.

Control measures:

- Government action
- Recycling operation in industrial plants
- Trees & forest Control pollution
- Conservation of forest
- Plant more trees
- Avoid discharge of untreated water into rivers, lakes.
- Industries should develop close-loop water supply scheme.
- Consulted by experienced person
- Public awareness

- Suitable laws,standards & practice

Characteristics(testing) of river water(waste water):*(2marks)*

1. Dissolvedoxygen (DO):

- Amount of oxygen dissolved in quantity of water at particular pressure & temperature.
- Support aquatic life in river.
- control river pollution
- Minimum level of DO is 4 mg/lit.

2. Biochemical oxygen demand (BOD):

- Amount of oxygen required for decomposition of organic matter in water.
- The rate of oxidation & demand depends on amount & type of organic matter in water.
- Complete oxidation occurs in indefinite period.
- Reaction period is taken as 5 days at $20^{O}C$.it is written as **BOD_5**.

3. Chemical oxygen demand (COD):

- Amount of oxygen required for chemical oxidation of organic matter.
- Using oxidizing agent like $K_2Cr_2O_7$ & $KMnO_4$.
- Determine the pollutional strength of river water.
- Rapid process & take 3 hrs.

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SOIL POLLUTION

(16 marks) or (8 marks)

Soil pollution is defined as***,"the contamination of soul by human and natural activities which may cause harmful effects on living beings".***

sources(causes) of soil pollution:

- **Industrial wastes**: Pulp and paper mills, chemical industries, oil refineries, sugar factories.
- **Urban wastes**: Plastics, Glasses, metallic cans, fibers, papers, rubbers, street sweepings, and other discarded manufactured products.
- **Agricultural practices**: Huge quantities of fertilizers, pesticides, herbicides, and weedicides are added to increase the crop yield.
- Apart from these farm wastes, manure, slurry, are reported to cause soil pollution.

- **Radioactive pollutants**: These are resulting from explosions of nuclear dust and radioactive wastes
- **Biological agents**: Soil gets large quantities of human, animal and birds excreta.

Effects of soil pollution:

- Alter the chemical and biological properties of soil.
- Reduce the fertility of the soil.
- Hazardous chemicals enter into human food chain from the soil and finally lead to serious effects.
- Radioactive wastes penetrate the soil and accumulate there by creating land pollution.

Control measures of soil pollution:

- Population growth
- Decrease of the available farm land due to urbanization
- Forestry and farm practices
- Proper dumping of unwanted materials
- Production of natural fertilizers
- Proper Hygienic condition
- Public awareness
- Recycling and Reuse of wastes
- Ban on Toxic chemicals.

SOLID (SOIL) WASTE MANAGEMENT
(OR)
WASTE SHED MANAGEMENT
(OR)
MUNICIPAL WASTE MANGEMENT (MSW)

- Management of solid waste is very important in order to minimize the
- Adverseeffects of solid wastes.

Types of solid wastes:

- **Urban wastes**
  Sources:
  - Domestic wastes – Food waste, Cloth, Waste paper.
  - Commercial wastes – Packing material, cans, bottles,polythene.
  - Construction Wastes – Wood, concrete debris.

- Bio medical wastes – Anatomical wastes, infectious wastes.

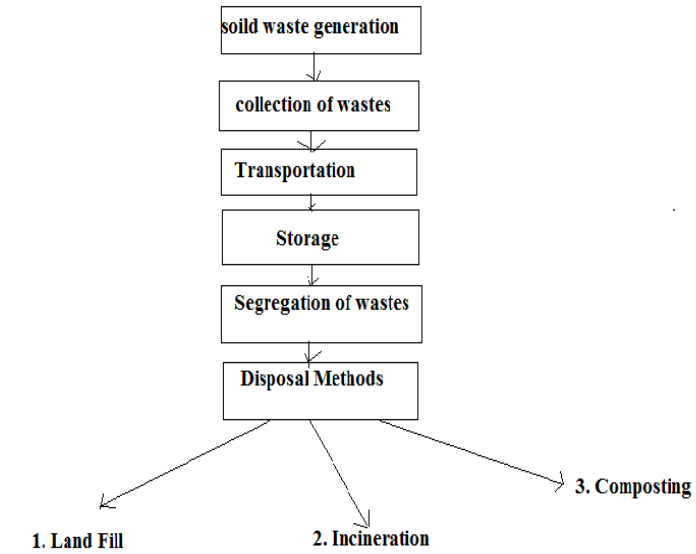
- **Industrial wastes**

  Sources:
  - Nuclear power plants – generates radioactive wastes
  - Thermal power plants – produces fly ash in large quantities

- **Chemical industries**
  - Produces large quantities of hazardous and toxic materials

Process of Solid Waste Management (or) waste shed management:

Flow chart



Steps Involved

- **Reduce, Reuse, Recycling (3R)**
  - Reduce the usage of raw materials: Usage of raw materials is reduced.
  - Reuse: refillable container which is discarded after using can be reused.
  - Throwing rubber ring from cycle tubes can be used again in the manufacture of rubber bands.
  - Recycling of discarded materials into new products.
  - **Eg:**Preparation of new cans and bottles from old aluminum cans and glass bottles.Preparation of fuel pellets from kitchen waste.
- **Discarding wastes**
  - Methods: a) Land fill b) Incineration c) Composting

Land fill:

- Solid wastes are placed in sanitary landfill system in alternate layers of 80 cm thickness of refuse
- Covered with selected earth fill of 20 cm thickness
- After 2 or 3 days solid wastes volume shrinks by 25-30%
- Then the land is used for parks, roads, small buildings etc.

Advantages

- Simple and economical
- Segregation is not required
- Landfill areas can be used for other purposes
- Natural resources are retained to the soil.

Disadvantages

- Large area is required
- Transportations cost is heavy.
- Bad odors, if landfill is not properly managed
- Insecticides, pesticides should be applied at regularintervals
- Causes of fire hazards due to formation of methane

Incineration (or) Thermal process:

- In this method combustible substances (rubbish, garbage, dead organisms) & non-combustible substances (glass, porcelain, metals) are separated first.
- The combustible waste substances are first dried in a preheater
- Then it is taken in a large incinerating furnace which incinerate about 100 to 150 tonnes per hour
- The temperature is maintained between 700oC to 1000oC
- The left out ashes & clinkers from the furnace is further disposed by landfill method
- The heat produced in the incinerator is used for generating electricity though turbines
- The non combustible substances are left out for recycling

Advantages

- Require little space
- Cost of transportation is not high
- Safest and hygienic
- Capacity 300 tonnes per day and can generate 3MV of power.

Disadvantage

- Operating cost is high
- Need skilled personnel

- Formation of smoke,dust & ashes

Composting:

- In this method the bulk organic waste is converted into fertilizer by biological action.
- The separated compostable waste is dumped in underground trenches(1.5m)
- Covered with earth of 20 cm and left over for decomposition.
- Micro organism (actinomycetes) is introduced to start decomposition.
- After 2 or 3 days the organic waste are destroyed bt micro organism and produce heat.
- Composting will happen at 75^{o}C.
- Finally the refuse can convert to powdery brown colored odorless mass called Humus(fertilizer).
- It contains lots of nitrogen, plants growth phosphates and other minerals.

Advantage

- Manure
- Industrial solid wastes can be treated
- Manure can be sold reducing the cost of disposing of wastes.
- Recycling.

Disadvantage

- Non-consumables disposed separately
- Not yet caught up with farmers

NOISE POLLUTION *(16 marks) or (8 marks)*

- Noise pollution is defined as,***"the unwanted, unpleasant or disagreeable sound that causes discomfort for all livingbeings."***
- Sound intensity is measured in decibel (dB).
- Normal conservation sound 35 dB to 60 dB
- Noise 80 dB&Painful 140dB

Types of noise:

1. **Industrial noise** (drilling sound, mechanical saws)
2. **Transport noise** (bus, trucks, motors, scooters, rail traffic noise)
3. **Neighborhood noise** (Musical instruments, TV, VCR, Radios, telephones, loudspeakers etc)

Effects of Noise pollution:

- This affects human health, comfort and efficiency.
- It causes muscles to contract leading to nervous breakdown, tension.
- It affects health efficiency and behavior.
- Loss of hearing due to excessive noise,
- Impulsive noise also causes psychological and pathological disorders.
- Brain is also adversely affected by loud and sudden noise as that of jet and aero plane noise.
- Ultrasonic sound can affect the digestive, respiratory, cardio vascular system.
- Rate of heart beat decrease or increase depending on the type of noise
- Blood is also thickened by excessive noises.
- Optical system is also affected by noise pollution & lead to colour perception & loss of night vision.

Control and preventing measures:

- ***Source control*** – acoustic treatment to machine surface, design changes, limiting the operationaltimings.
- ***Transmission path intervention***- the source inside a sound insulating enclosure, construction of a noisebarrier or provision of sound absorbing materials.
- ***Oiling*** – Proper oiling will reduce the noise from the machines.
- ***Receptor control***: Protection of the receiver by altering the work schedule, by using ear plugs etc.
- ***Planting trees also act as effective noise barriers***
- ***Different absorptive materials can be used to control interior noise.***

CASE STUDIES

(16 marks) or (8 marks)

Bhopal gas tragedy

- Industrial accident in Bhopal city M.P on night 3rd December 1984.
- At Union carbide India Ltd, which manufacture carbonate pesticides using methyl isocyanate(MIC).
- Exploded due to failure of cooling system & 40 tons of MIC leaked into atmosphere.

- **Nature of MIC**: It is a toxic gas, affects lungs, eyes & causes irritation in skin. Remove oxygen from lungs & cause death.

Effects

- MIC spread over 40 sq.km area.
- 5000 persons were killed.
- 65,000 people suffered from severe eye,respiratory, neuromuscular disorders.
- 1000 persons became blind.

Chernobyl nuclear disaster(Nuclear pollution)

- Nuclear pollution.
- In April 26,1986 melt down of Chernobyl nuclear reactor in Russia.
- Leaked out radioactive rays & radioactive materials.

Effects

- 2000 people have been killed by accident.
- More suffered due to degeneration of cells.
- Severe bleeding,anaemia,skin cancer.
- Animals,plants are affected more.

ENVIRONMENT (PROTECTION) ACT 1986*(8 marks)*

- It is a general legislation law to rectify the gaps & laps in above acts.
- This act empowers the Central Govt. to fix the standard of quality of air, water, soil & noise.

Objectives

- To protect & improvement of the environment
- To prevent hazards to all living creatures & property
- To maintain peaceful relationship between humans & their environment

Important Features of Environment Act

- Empowers safeguard measures to Prevent accidents which cause pollution.
- Gives remedial measures if accident occurs.
- The Govt. has authority to close or prohibit or regulate any industry & its operation.
- One who violates the act will be punishable with fine upto one lakh.
- If the violation continues, an additional fine of Rs. 5000/- per day is imposed.
- The act empowers the officers of Central Government to inspect the site / plant / machinery for preventing pollution.

- Collects samples of air, water, soil or other material from any factory / its premises for testing.

AIR (prevention and control of pollution) ACT 1981*(8 marks)*

- Enacted in the Conference held at Stockholm in 1972.
- Deals with problems related to air pollution, quality of air etc.

Objectives of air act

- To prevent, control & abatement of air pollution
- To maintain the quality of air

Important features of air pollution

- The Central Board settle disputes between state boards provide technical assistance & guidance to State board.
- The State Board verifies the emissions of air pollutants from industrial / automobile units.
- The State Board Collect information about air pollution
- SB examines the standards of manufacturing process & control equipment
- SB can advise State Government to declare the heavily polluted areas & advice to avoid burning of waste products.
- Operation of industrial unit is prohibited in a heavily polluted areaViolation of law is punishable with imprisonment & Fine

WATER (prevention and control of pollution) ACT 1974*(8 marks)*

- This act provides for maintaining & restoring the source of water
- Provides for preventing & controlling water pollution.

Objectives

- To protect water from all kinds of pollution
- To preserve the quality of water
- Establishment of Central & State Boards for preventing water pollution
- Restrain any person for discharging sewage/effluent into any water body
- Any contravention of the standards leads to prison for 3 to 6 months
- Requires permission to set up an industry which discharges effluent.

State pollution Control Board

- Take step to establish any industry, disposal system, extension/addition in industry, discharge of effluentinto river.
- Use any new / altered outlet for discharge of sewage.
- Begin to make any new discharge of sewage.

Punishment

- Stoppage of supply of electricity, water / any other services
- Imprisonment for 1years to 6 years & Rs. 5000/- fine.

WILDLIFE (protection) ACT 1972*(8 marks)*

- Aimed protect & preserve wildlife.
- Wildlife refers to all animals & plants
- It is declining due to human actions for wildlife's skins, furs, feathers, ivory etc.

Objectives

- To maintain ecological process & life supporting system
- To preserve biodiversity
- To ensure a continuous use of species.

Important Features

- Covers the right & non-rights of forest dwellers
- Provides restricted grazing in sanctuaries & prohibits in national parks
- Prohibits the collection of non-timber forest.

FOREST (CONSERVATION (or) PRESERVATIVE)ACT,1980*(8 marks)*

- Provides conservation of forests & related aspects.
- Arrest deforestation

Objectives

- To protect & conserve the forest
- To ensure judicious use of forest products

Important Features of Forest Act

- Forests are not diverted without the prior permission of the Central Government
- Land registered for forest may not be used for non-forest purposes
- Any illegal activity in a forest area can be stopped immediately
- Clearance of forest land for re-afforestation is forbidden
- One who violates the forest law is punishable.